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ABSTRACT

Mental ages for normals' and for retardates' achievement on 21 Piagetian measures of reasoning are presented in this exploratory longitudinal study. Before standardization data can be provided, a study which involves a more extended sample is necessary. It is, however, suggested that: (1) Normals' (IQ 90-110) transition from concrete to formal thought is not accomplished as early or in as complete a manner as has been indicated by previous studies; (2) While retardates (IQ 50-75) do achieve success on measures of concrete thought, they do not perform successfully on tasks involving formal or abstract thought processes; (3) Normals and retardates of equivalent mental ages do not necessarily possess equivalent flexibility in thought processes. Generally, a criterion performance on reasoning tasks was achieved by retardates at a later mental age than that noted for normals; and (4) The sequence of task accomplishments established in this study is essentially the same as that reported in Swiss studies by the Geneva group. Table 1 presents mental ages for achievement of Piagetian reasoning assessments. (Author/DB)

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MENTAL AGES FOR ACHIEVEMENT OF PIAGETIAN REASONING ASSESSMENTS *

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Work by Piaget and his collaborators has established that the development of reasoning proceeds through a series of hierarchical stages. Educational programs which evolve from these findings appropriately attend to an individual's present stage or level of functioning rather than to his age. Yet Americans, who traditionally are supplied with standardization test data which set forth a subject's accomplishments in terms of mental age, find the Geneva group's disregard for age disconcerting. When scores for twenty-one Piagetian assessments were available from a current longitudinal study on the the development of reasoning in normals and retardates (Stephens, Miller, & McLaughlin - 1969) it was possible to determine the mental age at which both normal and retarded subjects achieved successful performance on these measures and to compare retardates' mental age of achievement with that of normals.

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Methodology

The longitudinal study, now in its fourth year, provides for the re-

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assessment of reasoning every two years. To date, two waves of data-gathering have been accomplished. Measures used in the study are grouped under four headings:

Conservation:

Conservation of Substance (Piaget and Inhelder, 1941)

Conservation of Weight (Piaget and Inhelder, 1941)

Conservation of Volume (Piaget and Inhelder, 1941)

1. Does density of object change with transformation of shape?
2. Is there a relationship between weight and volume of an object?

Conservation of Length (Piaget, Inhelder, and Szeminska, 1964)

Conservation of Length - Rod Sections (Piaget, Inhelder, and Szeminska, 1964)

Conservation of Liquids (Piaget, 1952)

Dissolution of Sugar (Inhelder, 1968)

1. Substance: After the sugar dissolves is there still sugar in the glass?
2. Weight: Is weight unchanged as sugar dissolves?
3. Volume: After dissolution is there as much sugar as before?

Dissociation of Notions of Weight and Volume (Inhelder, 1968)

One-for-One exchange (Piaget, 1952)

Term-to-Term Correspondence (Piaget, 1952)

Logic - Classification:

Class Inclusion - Animals (Piaget and Inhelder, 1964)

1. Demonstrate relation of sub-categories to categories with pictorial symbols (ducks, birds, animals)

2. Manipulative placement of objects in sub-categories and categories.
3. Analysis and synthesis of categories
4. Manipulation of abstract categories

Class Inclusion - Beads (Piaget and Inhelder, 1964)

Changing Criterion (Piaget and Inhelder, 1959)

Intersection of Classes (Piaget and Inhelder, 1959)

Relationships - Brothers & Sisters (Piaget, 1964)

Relationships - Right & Left (Piaget, 1964)

Operativity and Symbolic or Mental Imagery:

Rotation of Squares (Piaget and Inhelder, 1963)

1. Draw anticipated rotated position
2. Select card which contains anticipated rotated position

Rotation of Beads (Piaget, 1952)

Transfer from 2 to 3 Dimension (Piaget, Inhelder, & Szeminska, 1964)

1. Determine point of placement for object in 2-dimensional space
2. Determine point of placement for object in 3-dimensional space

Changing Perspectives (Piaget and Inhelder, 1964)

1. Mobile - indicate drawing which represents complex when viewed from different perspectives.
2. Stationary - seated subject indicates where a person must stand to see perspective corresponding to a drawing.

Combinatory Logic

Combination of Liquids (Piaget and Inhelder, 1964)

Sample

The sample (N=150) is composed of 75 normal (IQ 90-110) and 75 retarded (IQ 50-75) subjects. The two sub-samples, normal and retarded, are divided into cross-sectional samples of three age [illegible].

1. 25 retarded subjects (13 males, 12 females);
   25 normal subjects (13 males, 12 females);
   Ages: Wave I - 6 to 10; Wave II - 8 to 12
2. 25 retarded subjects (12 males, 13 females);
   25 normal subjects (12 males, 13 females);
   Ages: Wave I - 10 to 14; Wave II - 12 to 16
3. 25 retarded subjects (13 males, 12 females)
   25 normal subjects (13 males, 12 females)
   Ages: Wave I - 14 to 18; Wave II - 16 to 20

Normal subjects were randomly selected from public school classes in the Greater Philadelphia area; mentally retarded subjects were randomly selected from special education classes in the same schools. Initially, subjects were screened for inclusion through administration of the WISC or WAIS. Sub-samples (normals and retardates of specific age groups) were stratified in terms of social status as measured by Warner's Index of Social Status (McGuire & White, 1955).

Data Analysis

Responses for normal subjects (N=75) were tabulated in terms of mental age intervals (six through 16+). Task attainment was defined as the earliest age at which 50% of the subjects in that mental age interval achieved satisfactory performance. If a 50% attainment was not achieved at any age interval

then performance was labeled unattained. The same criterion procedure was repeated when data for retardates was tabulated. Mental age range for retarded subjects was three through 16+. Earliest mental ages for achievement of criterion performance on the 29 reasoning variables for normals and for retardates are set forth in Table 1.

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Insert Table 1
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Discussion

There is acknowledgement that tabulation of the reasoning scores constitutes an exploratory effort which does not purport to meet the criterion for standardization data. The limitations evolve from a restricted sample: i.e., (1) the study involves only 75 normal and 75 retarded subjects; (2) the IQ range is limited,90 to 110 for normals, 50 to 75 for retardates; (3) the chronological age range for both groups is six through 20. In addition, Wechsler Intelligence Scale scores cannot be converted to MA's higher than 16. It is also noted that criterion ages derive from Waves One and Two of data collection. When time provides additional waves of data the criterion ages may alter. Nonetheless, the findings serve to suggest the degree to which "stage" in Piagetian terms can be equated with mental age.

For normals,IQ 90-110, the mental age for achievement of 22 of the 23 concrete thought variables was MA six to 12. The one remaining task, Class Inclusion-Animals-5a, which involved hierarchical classification and which is purported to require performance at the concrete level was not achieved until MA 16. One measure of formal thought, Combination of Liquids, which involved combinatory logic, was achieved at MA 12. On two other

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measures of formal thought, Dissolution of Sugar (Volume) and Dissociation of Weight and Volume, normals achieved criterion performance at MA 13. The two sub-tasks in Conservation of Volume, however, were not achieved until MA 14 and 15. The remaining assessment of formal thought, Transfer from Two to Three Dimensions, was not achieved until MA 16+ (actually, the subjects who achieved success had CA's of 19 and mean IQ's of 110). Thus normal subjects do not appear to make the immediate and complete transition from concrete to formal thought between the ages of 11 to 13 that has been indicated by previous Piagetian workers (Stephens, 1966).

Mental age range for criterion performance for retardates on 22 measures of concrete thought was five through 16. Criterion performance was unattained by the retarded subjects on the six measures of formal thought and on the hierarchical classification task, Class Inclusion-Animals-5a. The fact that retarded subjects, even those with mental ages of 15 or 16, did not perform successfully on measures of formal thought lends credence to Inhelder's (1968) statement that to be retarded (educable) is to perform at the level of concrete but not formal (abstract) operations.

Review of Table 1 indicates that the sequence of task accomplishment is essentially the same as that recorded in Vinh-Bang's (1964) analysis of Genevan protocols: i.e., Conservation of Substance preceded weight, and weight preceded volume. However, in the present analysis the interval between achievement of conservation of substance and achievement of conservation of weight was in terms of months rather than years. Both tasks were successfully accomplished by normals at MA 7 and by retardates at MA 10.

On only two variables were equivalent mental ages noted for normals' and retardates' achievement of criterion performance. For four of the measures on which both normal and retarded subjects demonstrated early mastery the mental age for the retarded group was younger than that for normals. There is reminder, however, that no normal included in the sample had a mental age of less than six. Had the study provided for inclusion of normals below six in mental and/or chronological age criterion performance on some of the measures, particularly Intersection of Classes and Rotation of Beads, probably would have occurred at a younger mental age. Subjects in the younger age group of retardates frequently had MA's of less than five, and on one measure they achieved criterion performance at MA five. There is an acknowledged need for extension of the study to lower age groups.

On four measures - Rotation of Beads, Conservation of Length-Rods, Conservation of Liquid, and Term to Term Correspondence - the mental age for retardates' achievement was one year in advance of that for normals. On twelve of the remaining measures of concrete thought the mental age at which normals attained criterion performance was from two to six years younger than the age for retardates. Thus, mental age equivalent to that of normals does not insure that retardates will have comparable flexibility of thought or the operatory processes which are required to achieve reversibility in conservation tasks, to categorize and sub-categorize in classificatory tasks, and to anticipate changes in perspectives when objects are viewed from various positions. In the past it has been considered proper to supply retardates with learning tasks which are appropriate for normals of equivalent mental age (as determined by the Stanford-Binet or the Wechsler

Intelligence Scales). Findings from the present study suggest that it may be more appropriate to locate a retardate's level of functioning on the Piagetian sequence of reasoning tasks and to provide opportunity for experiences appropriate to that level.

Summary

Mental ages for normals' and for retardates' achievement on 21 Piagetian measures of reasoning are presented. There is the reminder, however, that restrictions due to sample size, intelligence range, age span, and mental age make the study an exploratory one. Before standardization data can be provided a study which involves a more extended sample is necessary. Nonetheless, there are suggestions that:

1. Normals' (IQ 90-110) transition from concrete to formal thought is not accomplished as early or in as complete a manner as has been indicated by previous studies.

2. While retardates (IQ 50-75) do achieve success on measures of concrete thought they do not perform successfully on tasks involving formal or abstract thought processes.

3. Normals and retardates of equivalent mental ages do not necessarily possess equivalent flexibility in thought processes. Generally, criterion performance on reasoning tasks was achieved by retardates at a later mental age than that noted for normals.

4. The sequence of task accomplishments established in this American study is essentially the same as that reported in Swiss studies by the Geneva group (Vinh-Bang, 1964).

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TABLE 1

MENTAL AGES FOR ACHIEVEMENT OF PIAGETIAN REASONING ASSESSMENTS

	Assessments	Normals	Retardates
1.	Intersection of Classes	6	5
2.	Rotation of Beads	6	7
3.	One for One Exchange	7	5
4.	Conservation of Length	7	5
5.	Rotation of Squares (2)	7	6
6.	Term to Term Correspondence	7	8
7.	Conservation of Liquid	7	8
8.	Conservation of Length - Rods	7	8
9.	Conservation of Substance	7	10
10.	Dissolution of Sugar (Substance)	7	10
11.	Conservation of Weight	7	10
12.	Class Inclusion - Animals (5b)	7	10
13.	Class Inclusion - Beads	7	10
14.	Class Inclusion - Animals (4)	7	12
15.	Relationships - Right and Left	7	13
16.	Class Inclusion - Animals (3)	8	10
17.	Relationships - Brothers and Sisters	8	10
18.	Changing Criterion - Total	8	13
19.	Dissolution of Sugar - Weight	9	9
20.	Rotation of Squares (1)	11	11
21.	Changing Perspectives (Stationary)	11	16

TABLE 1 (Cont.)

MENTAL AGES FOR ACHIEVEMENT OF PIAGETIAN REASONING ASSESSMENTS

	Assessments	Normals	Retardates
22.	Changing Perspectives (Mobile)	12	15
23.	Combination of Liquids	12	Unattained
24.	Dissolution of Sugar (Volume)	13	Unattained
25.	Dissociation of Weight and Volume	13	Unattained
26.	Conservation of Volume (1-3)	14	Unattained'
27.	Conservation of Volume (4)	15	Unattained
28.	Class Inclusion - Animals (5a)	16	Unattained
29.	Transfer from 2 to 3 Dimensions	24	Unattained